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Objectives were to determine whether a technological device could teach five-year-olds to read, over what intelligence ranges the instument would be effective, whether Negro children from a recently closed segregated school would respond, and whether the device could teach mentally retarded children.

Subjects were 22 kindergarten pupils from one school and a control group of 22 pupils matched according to age, sex, race, intelligence, left and right handedness, hearing, vision, language maturity, and socioeconomic status. The device used was the Edison Responsive Environment Instrument, a computerized typewriter that reproduces several human sensory responses. The instruments were housed in booths which provided isolation from distraction and were monitored by trained personnel. Subjects came voluntarily for 30 minute sessions over a five month period, the actual time at the E.R.E. ranging from 22 to 36 hours.

Evidence indicated that twenty kindergarten and mentally retarded children (two subjects dropped out) learned to read significantly better through use of the E.R.E. than twenty children matched in numerous ways who were taught by enriched conventional reading methods. Scores of slower children were as significantly superior as those of more intelligent children. There were no observed sex or racial differences. It was felt that if the experiment had continued, the differences between the experimental and control groups would have been greater.

Implications for further research included the suggestion for exploitation of the E.R.E. as a multi-sensory method of teaching, for using the machine with very young children, and for using the device to teach reading quickly and early on the assumption that learning to read well results from early success followed by extensive reading.

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FREEPORT PUBLIC SCHOOLS EXPERIMENT ON EARLY READING USING THE EDISON RESPONSIVE ENVIRONMENT INSTRUMENT

By Dr. John Henry Martin

ED002586

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

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Mrs. Dorothy Johnson, Director of Primary Reading in Freeport, New York Public Schools and Associate Director of the E.R.E. Project, responds to a signal of a child who is learning to read on an Edison Responsive environment computerized typewriter. Ordinarily the door to the booth is closed and the child is not distracted. (The door was left open in this photo for illustration purposes.) The adult observes the child's progress, unseen, through the one-way viewing mirror.

"Freeport, under Superintendent Martin's leadership, has made a highly important contribution to research and innovation in education through their experiment with the ERE instrument. The results are exciting and I hope will stimulate other communities to explore the potentialities of this instrument as a teacher of reading. I congratulate both Dr. Martin and the Edison Laboratory for undertaking this project."

Dr. James E. Allen, Jr., Commissioner, New York State Dept. of Education

A REPORT ON THE FREEPORT PUBLIC SCHOOLS EXPERIMENT ON EARLY READING USING THE EDISON RESPONSIVE ENVIRONMENT INSTRUMENT

By John Henry Martin*

Preview

Twenty kindergarten children, five years old, were taught to read on Edison Responsive Environment machines over a period of five months. The level of reading proficiency for the group as a whole was near second grade at the close of the experiment in June 1964. The average time of exposure to the automated self-instruction was less than thirty hours – ranging from twenty-two to thirty-six hours per child. One of the peculiar virtues of the E. R. E. machine is its capacity to provide tutorial attention and response to every action of a child: Instrumentation such as the E. R. E. can help significantly to solve many of the problems in the public schools today.

Background and Setting

In the summer of 1963 the Thomas A. Edison Laboratory and their associates, the Responsive Environments Corporation, invited the Freeport Public Schools to conduct an experiment to determine the validity of their E. R. E. Instrument as a teacher of reading to kindergarten and mentally retarded children.

After discussions with the Commissioner of Education for the State of New York, Dr. James E. Allen, Jr., and members of the State Department of Education, it was decided to proceed on a local basis with some State research funds being made available if needed. The Freeport Board of Education supported the entire project without stint and with unanimous agreement.

Freeport, Long Island, is a suburban village of 40,000 population some 35 miles from New York City. The public schools have a population of 7,000 with approximately 4,000 in five elementary schools. In July 1963, the Board of Education directed that a sixth elementary school, over 90% Negro, be closed, and the children be distributed to the other schools in the district. The Atkinson School where this experiment was conducted, one of the five remaining schools with a population of over 600 children, thus became approximately 20% Negro. This school contained the only classes in the Freeport Schools for mentally retarded children of elementary school age. Thus, the Atkinson School made available a comprehensive sample of a general public school population.

Its four kindergarten classes divided into two morning and two afternoon groups contained 115 children. The one primary class for mentally retarded consisted of 14 children.

The Experiment

A statement of the problem was: "Could a technological device teach five-year-olds to read?" Simple analysis of the problem revealed several subsidiary questions. Over what intelligence range would the instrument have any consequences? Would Negro children from a recently closed segregated school respond? Would mentally retarded children learn to read from an instrument?

Twenty-two children were selected, eleven for each of the two available machines. A matching control group was simultaneously identified. These groups were matched over a range of criteria covering age, sex, race, intelligence, left and right handedness, hearing, vision, language maturity, and socio-economic status as measured by parental job classification. Binet intelligence tests were made of every individual in the experimental and control groups by qualified psychologists. All pretesting was completed in November 1963. By June 15, 1964 two subjects were lost to the experiment by moving from the district.

The Classroom Environment

Two years ago, the kindergarten teachers were invited by the supervisors of reading to use reading materials within the regular program of their classrooms. It was generally agreed that too doctrinaire an adherence to child development views in the past had isolated some able kindergarten children from learning to read. In the kindergartens of the Atkinson School were two mature and superior teachers each with more than ten years of teaching experience, with advanced degrees in elementary school education and reading. Both classrooms were richly equipped and were well supplied with materials of instruction.

The Control Group

Under these circumstances the general assumptions underlying a control group could not obtain. It became apparent that our control children would not be in a standard kindergarten where formal or informal reading instruction would not take place. Nor would it be possible to isolate our experimental group from some exposure to classroom instruction. It was possible to anticipate that a reverse Hawthorne effect could develop. At the Hamden Hall Country Day School, Hamden, Conn., where O. K. Moore conducted the first

*Now Superintendent of Schools, Mt. Vernon, New York.

research into the applied theory which led to the development of the Edison instrument, one or more members of the teaching staff were reported to have revealed competitive antagonism to the withdrawal of their children to receive half-hour reading instruction in Professor Moore's research program. Similarly, in the year and one-half before the automated Edison instrument had appeared, Moore-trained reading teachers from the Freeport staff had observed the same reaction when they taught children to read from regular kindergarten and first grade rooms using a modified electric typewriter in a tutoring situation identical to the Moore pattern. Under these circumstances it was reasonable to expect that the arrival of technological instruments of a complexity never before seen in a common school would generate competitive anxieties in teachers possessing a high degree of professional competence and pride. We were not to be disappointed.

Faced with these situations we could not offer the control subjects a 'placebo' of nothing while we administered a new E. R. E.—medication to the experimental group. Rather, we were confronted with the difficult situation where we could be reasonably certain in advance that our control children would receive the best primary reading program that stimulated teachers could devise while maintaining the best aspects of a good child-centered kindergarten. Nor would the research picture remain clear of the effects upon the experimental group of their being withdrawn from their kindergartens daily for one-half hour or more (approximately one-quarter of their day), to return to some incidental exposure to the reading instruction being given tutorially and in small groups to the other children in the class. We recognized that until pre-school children from essentially impoverished environments without tutorially minded parents are used as experimental subjects we shall not be able to completely eliminate certain factors which influence results.

But given these circumstances, which in one form or another affect all studies conducted within social institutions, our results would have to be examined against a restatement of the purpose of the experiment. "Could the E. R. E. instrument teach children to read better than a matched control group who would be taught to read under the best of conditions through the use of regular reading materials and procedures?" In effect, it was possible to anticipate that the normal Hawthorne affect which stimulates the participants in an experimental situation to higher energy output (because of the sense of being part of something special) would in this situation more likely accrue to the control children and their teachers to a degree seldom found or accounted for. On the contrary the sense of being "special" would occur to our experimental group as well. Albeit, that they would be the ones who would leave their classes to go to a distant room voluntarily to enter an isolation booth to play and work with a "talking typewriter."

The Nature of the E. R. E.

The Edison Responsive Environment Instrument, E. R. E., is a computerized typewriter that reproduces several of the sensory responses of a human being. That is, it talks, it listens, it accepts, it responds, it presents pictorial or graphic material, it comments or explains, it presents information, and it responds to being touched. It can be orchestrated to do each of these things in a straight line sequence or in planned parallels of these different sensory behaviors.

For the purpose of this experiment very limited exploitation was made of the instrument's capacities. We frankly have only now, after five months' work, gained some insights into 'feeding' the mouth of this benign and neutral machine. Programming, as the term is currently used, is largely a linear concept of the presentation of printed material in planned sequences with or without pictorial material, with or without audio and with or without branching materials based upon a limited anticipation of the learner's responses. The E. R. E. differs from this concept of programming analogously to the difference between an old-time player-piano and a symphonic orchestra which has been computerized. The first is a mechanical device which can be activated by punched rolls of paper. The second will make different instrumental sounds to produce a symphonic effect as simply or complexly as the score which can be written to activate it. In other words, the E. R. E. is not fixed to any sequence of behavior or responses. The key to a fuller utilization of its many capacities will come from seeing it as *Multi-Sensory Methodology open to simple and varyingly complex behaviors as well as responses from the learner who uses and controls it.*

E. R. E.—A Working Description*

A few examples to illustrate the Multi-Sensory Methodology capabilities of E. R. E. are:

In its simplest operation, the depressing of any key by the pupil will result in the immediate pronunciation of the particular key-symbol and also in the instantaneous typing of that symbol on the typewriter paper in extra large type-style.

Not only must the keyboard be "jam-proof" but, most important, once a key has been depressed, no other key of the total keyboard can be depressed until the audio-pronunciation is completed. Otherwise, this would lead to "wild-typing" and jibberish audio pronunciation.

Even in this simple form of operation, a number of variations were proven to be essential; of particular importance is the ability to pre-record the keyboard in "several languages" even for the teaching of reading and writing of the "natural language." In order to teach sound analysis of the spoken word resulting in written (typewritten) symbols, one should be able to record the alphabet-keys in their phonetic equivalents

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**This section appropriately was prepared by Richard Kobler, the technical creator of the Edison Responsive Environment Instrument.*

A kindergarten child at Atkinson Elementary School, Freeport, New York, composes her own story on an Edison Responsive Environment System (E.R.E.).

as well as their letter-names. For example "t" (tee) or "t." A third variation may consist in the combining of phonetic equivalents and letter names, such as "tee-t." One must be able to switch from one language to the other effortlessly dependent upon the student's own requirements.

It is further necessary to be able to delay the audio response to give an advanced student an opportunity to "beat the teacher" with the pupil's own pronunciation of the key-symbol.

In an advanced stage of teaching, E. R. E. adds to these functions the visual exhibition and accompanying audio explanations of single letters, words, sentences, and stories. The Pointing Mechanism must be such as to gradually expand the visual focus of the pupil: thus, single letters can be exposed and pointed to, either in complete isolation or gradually coupled with other letters to form words; later on, a whole printed line is exposed, and lastly, several lines may be exposed.

Probably one of the most important features of the E. R. E. System is the fact that any symbol pointed to by E. R. E. is also "encoded" in its keyboard. This means that this particular key is the *only one* which can be operated by the pupil and which will type its symbol on the typing paper, while all other keys are inoperative (blocked).

Because incorrect responses cannot be completed on the "blocked" keyboard, this approach has aptly been called the "trial and success" method.

A typical operation would be for E. R. E. to point out a particular letter, to pronounce this letter to the pupil, and to free the one single, particular key corresponding to this symbol for manual operation by the pupil. The moment the pupil depresses this key, the pointer will move to next symbol, pronounce it, and free the corresponding key on the keyboard. Here, again, it must be possible for the E. R. E. to pronounce symbols in the before-mentioned two or three modalities (letter names and phonames) dependent upon the program.

Suppose that E. R. E. is pointing to a letter, has pronounced it, and has freed the corresponding key for operation by the pupil. If at this moment, the child's mind "wandered away," a *stalemate* between child and instrument would develop which would call for the intervention of a human teacher and probably end in the termination of the pupil's session with E. R. E.

E. R. E. avoids such a stalemate by audibly repeating the pronunciation of the last letter every few seconds until the pupil operates the corresponding key.

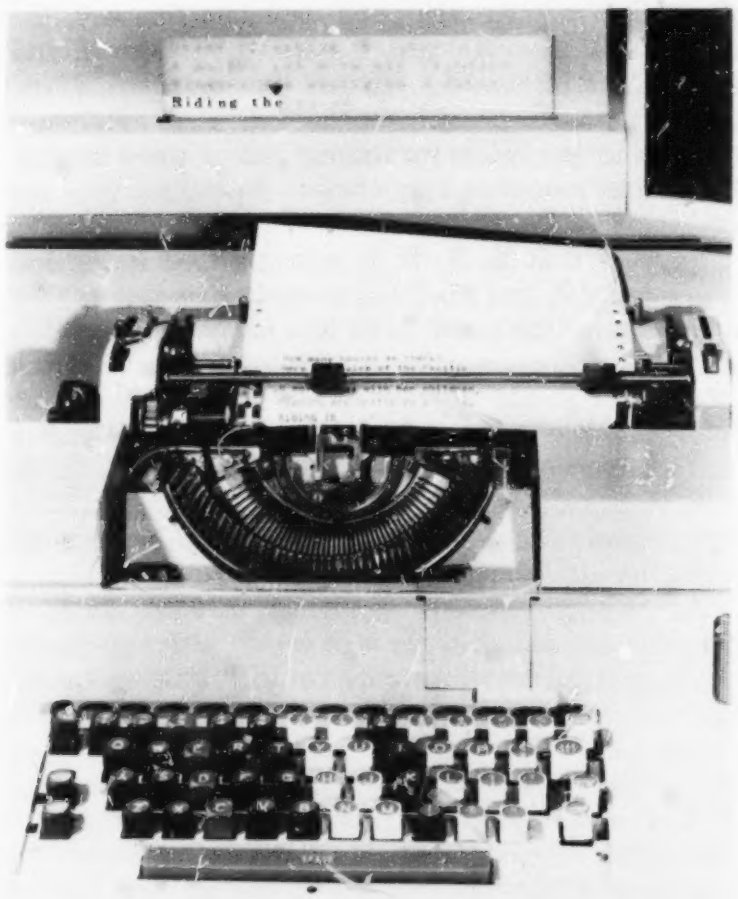
As the pupil proceeds from letters to words, *an additional* audio system takes over which, although it can be programmed to take effect *at any* time or special point of the program, is frequently activated when the "space-bar" is depressed by the pupil. Since the depression of the "space-bar" indicates the end of a word, E. R. E. will at that point pronounce and spell the word just typed. Similar rules hold true of the audio-recapitulation of a total sentence after "period" and even of total paragraphs or stories.

Usually after the pupil has become familiar with a number of words, the audio pronunciation of *individual letters is cut out* because pupils want to proceed at a faster pace and start to resent audio repetitions of things they know in whole word form.

At this point we shall give another example of the *purposeful withdrawal* of a sense-modality (the withdrawal of a "letter audio" was one example). This time we shall *cut out the visual exhibition* of words or sentences and E. R. E. must be able to *ask the pupil* to type certain words or letters based only upon the pupil's audio-reception. This of course is "writing" and furnishes proof of the pupil's absorption of material. The only "help" given is that the keys are sequentially encoded.

Finally, in order to give precisely controlled "gestalt-illustrations" of orthographically presented materials, pictures can be shown to the pupil in close relation to the rest of the program. This is accomplished through an automated rear-projection-instrument built into E. R. E.

As powerful as these multi-sensory, synchronized activities of E. R. E. may be, they frequently are insufficient, if it were not for the ability of E. R. E. *to record the pupil's voice and to automatically play it back to him* in such a manner as to compare his own talk with the *models prerecorded in the E. R. E. System*. All these functions have to be totally synchronized with all other visual and audible as well as tactile stimuli. Having built a word from its visual, tactile, and audible components, having summarized it phonetically, having spoken it and compared it with



Pointer in E. R. E. viewer indicates next letter to be typed.

the pronunciation of the E. R. E., a perceptual ring has been closed which not only results in the learning of the *reading* skill of the natural language, but also in the *writing* skill, based upon the *phonic analysis* of the pupil's own speech and therefore results in a *re-learning of the spoken natural* language on a higher plane.

All of these functions must be easily programmed by electronically and mechanically unskilled personnel. The mere typed copy of the text of a card by an attendant and the operation of a few auxiliary keys will automatically program E. R. E., using a simple card containing not only the visual information but the total encoded program as well as all audio explanations. Each single card may contain as many as 120 words accompanied by 20 minutes of audio explanations.

Testing Schedule

Because the delivery of the two machines was originally scheduled for December 1963, pre-test data on the children was undertaken in November 1963. At that time the experimental group was fixed in size at twenty-two, the estimated capacity of the two machines in the typically short kindergarten school day. Among the tests used to establish the equivalency of the control group were the Binet I. Q.,[1] and two reading tests, the Lee-Clark,[2] and, the Wide Range Achievement Tests.[3] The I. Q. distribution of both the experimental and the control groups ranged from the 140's to the 50's. The original groups were arranged in matched pairs in five categories of intelligence from Superior (120-140), Bright (112-118), Average (90-107), Dull (80's), to Retarded (50's to 70). The forty children who remained in June 1964, divided into twenty Experimental and twenty Control, were distributed in threes, fours and fives in each of the above five intelligence categories.

The scores achieved on reading tests in November 1963 were used to refine the matching of the pairs and the total group, and to provide the bases for comparative measures.

Final testing was done during the weeks of June 8th and 15th, 1964. At that time, the Gates reading test was administered to both groups.

The Administrative Program

The twenty-two children in the experimental group, eighteen from four different kindergartens, and four children from a special primary class for mentally retarded children, came voluntarily for thirty-minute sessions, the maximum time permitted to work with the two E. R. E. instruments. After the first introductory week, the children left their rooms and found their way to the second floor classroom into which had been built two demountable, sound and air-conditioned, plywood booths approximately eight feet in cube that housed the E. R. E.'s and provided isolation from distraction and adult intrusion. The booths were monitored through one-way vision glass and intercom phones by trained teachers or clerks.

Training of the adults consisted primarily in teaching them how to establish a non-directive relationship with the children. Children could signal a desire to leave the booths or ask a question by raising a hand. Prompt response was expected and given provided it was non-instructional. Special note should be made of the successful effort to produce a calm and tranquil atmosphere in the experimental center. Mrs. Dorothy Johnson, Director of Primary Reading in the Freeport Public Schools, as well as Associate Director of the E. R. E. Project, not only did this, but in her manner and person contributed beyond measure to every aspect of the program. No one ever spoke in loud tones. Hurry was forbidden. A generally pleasant hush was maintained in order to keep the children in a neutral atmosphere. We wanted neither tensioned-fright nor overstimulated excitement. The staff achieved this goal despite the almost continuous flow of visitors.

Results

A SUMMARY OF THE STATISTICAL ANALYSIS* OF THE TEST DATA

A statistical study and analysis of the data was made by Dr. Frederick L. Matthews, of STACO, Williston

1. The Revised Stanford-Binet Intelligence Scale, Sec. Ed.
2. Reading Readiness Test, Kindergarten And Grade 1, 1962 Revision, California Test Bureau Publishers.
3. The Wide Range Achievement Test, Published by the Psychological Corp. 5th Avenue, New York, N. Y.

Park, New York. A brief summary follows: Dr. Matthews found a correlation of 0.977 between the I. Q. test scores administered in November 1963 with those given in June 1964.

In an effort to determine which of the three post reading tests administered was most significant, factor analysis was used.

The test with the highest communality was the criterion employed, i.e., the test with the highest correlation with the other two was presumed to be the best.

The Gates Test had an r = 0.8 to Lee-Clark
r = 0.8 to Wide-Range

When Gates was eliminated the correlation of Lee-Clark with Wide-Range was 0.35. On this basis Gates was the best criterion.

When the same procedure was used with the Pre-test results the correlation between the Binet and the Lee-Clark was 0.27 and with the Wide-Range, it was −0.36. Essentially the correlations between the I. Q.'s and the pre-test-reading tests were zero. The correlation between Lee-Clark and Wide-Range was 0.42.

On the basis of the Lee-Clark pre-test data and the Gates post-test results a regression line was graphed, using the least squares method. The actual scores were found to range on either side of the regression line in a normal bell-curve of distribution. The same procedure was duplicated for the control group. No significant difference was found in the slopes. The slope of the experimental group was 0.021778 and that of the control group was 0.0180 *with 1.7 months difference in favor of the experimental group scores.*

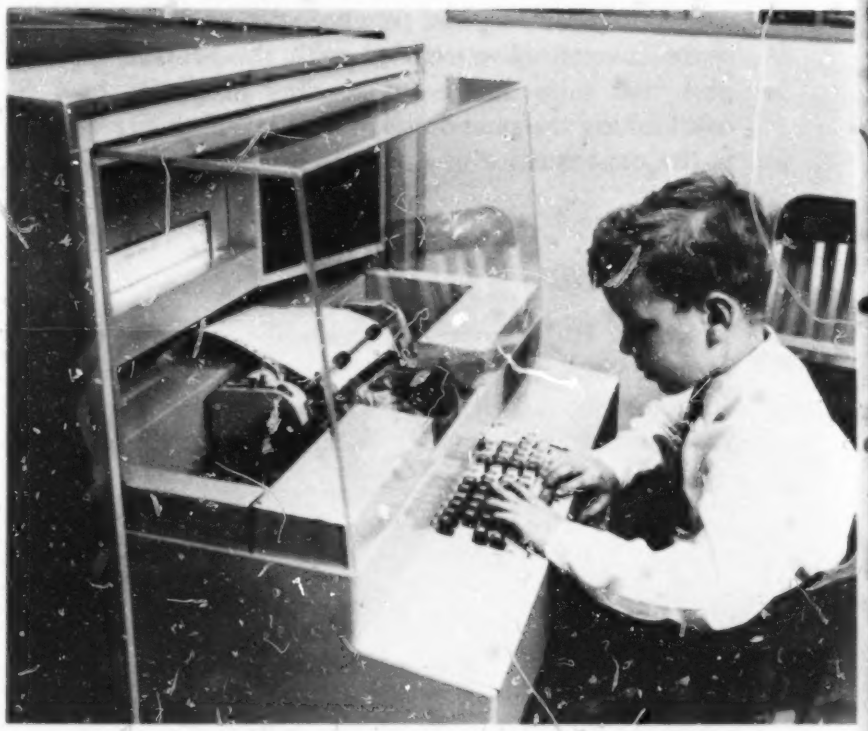
To test the significance of this difference, Dr. Matthews pooled the two slopes equal to 0.0199456 and found that the mean of the experimental scores lay outside the confidence limit of the controls. That is, the mean of the experimental scores exceeded over 90% of the scores achieved by the control group.

Using the "chi" or "goodness of fit" test to test the assumption in the preceding statistics of normal distribution in determining the accuracy of the means, the results were identical.

To subject the data to another test, the regression lines were divided into three equal parts using variance analysis on each part in each group to check the linearity of each regression in each part. The results were remarkably consistent.

One more statistical procedure was applied to the data. The statistician simulated an augmented group by random numbers with replacement to show how big a sample would be needed to produce a significant difference in the slope. He found that control and experimental groups of 75-100 each would do.

**The use of a series of statistical techniques more complex than normally expected for a study of such numbers in addition to the simpler procedures also employed was deliberate'y done to apply the severest of disciplines to the results. We recognize the possible criticism of using heavy artillery instead of small bore shotguns.*



This child was part of a group of kindergarteners who taught themselves to read entirely without formal human instruction in an average of less than 30 hours of instrumented instruction.

Observations

1. The E. R. E. Instrument has scarcely been exploited as a Multi-Sensory Methodology of teaching.
2. The material prepared during this project for the instrument represents less than twenty hours of instruction time. There is subjective evidence to indicate that only a fraction of these cards carried the major burden of the learning consequences.
3. Additional research is needed to explore the coordinations of the various sensory modalities of the instrument.
4. Exclusive E. R. E. instruction of the very young should produce results superior to those presented here.
5. The predictions that children over four would do poorly with the instrument were not substantiated by our findings.
6. The one case of the 18-year-old Negro boy with a "sight reading vocabulary of less than thirty words" three months ago, who now reads as the unique contribution of the E. R. E., is not generalizable. But the temptation and need to test this field is as immense as the problem.
7. Certain techniques are of importance and were too little used in this project. Desk top slates for tactile confirmation of letter and word learning are of presumptive value. Books distributed to the participants early after their exposure to the instrument should add to the consequences if the one-week experience at the end of this project is an indicator.
8. There is strong subjective feeling that the E. R. E. may make its greatest contribution as a rapid, three to five months "gestalt-producer" for early reading. Our

associate director, chief psychologist, and the other research personnel associated with the project, all suggest that long drawn-out reading programs may be overlooking the phenomenon that learning to read well is the consequence of *early success* followed by much reading.

Conclusions

1. The E. R. E. Instrument taught within five months (actual time at instrument ranged from 22 hours to 36 hours) twenty kindergarten and mentally retarded young children to read significantly better than twenty children carefully matched by a series of criteria who were taught by enriched traditional reading methods.
2. The children with less intelligence scored as significantly superior as did the brighter children.
3. Negro children in the group were indistinguishable by their scores from the remainder of the group.
4. Sex differences were not apparent in the scores.
5. The mean difference for the experimental group in reading score at the end of the five month period was 1.7 months over the control group.
6. There is evidence to indicate that the difference between the experimental group and the control group would have increased had the experiment continued.

Extract from a report by Dr. Lassar G. Gotkin to Dr. Martin Deutsch both of the Institute For Developmental Studies

"Our initial experiences with the machine suggest that we have underestimated its potential as both a research instrument and an instructional device. We have made a major change in the use of the machine. To date, the children using the machine sat in an enclosed cubicle completely isolated from any stimulation other than the machine itself. This approach, in harmony with some Skinnerian concepts, seems to be central to Moore's conception of responsive environments. While much in sympathy with the conceptual framework which emphasized removing the learner from irrelevant stimulation that would interfere with learning, I had decided to do away with the booth for practical reasons involving full school use of the equipment. Richard Kobler and I corresponded about the matter and especially my suggestion that earphones could make up for a major portion of the booth's isolation.

"The shocking observation that we have made this summer in using the machine with five-year-olds without the booth and without the earphones is that they attend to the machine despite a variety of stimulation that would distract even a motivated adult. The incident that highlighted this condition occurred during a time when there were six observing adults in the room and bedlam outside in the schoolyard where 200 children were cheering relay races. During this time the children worked on the machine as if it were perfectly quiet and no one was there. The importance of this observation is relevant in terms of the many observations made that children from socially disadvantaged environments have attentional problems.

"As we have been working with children from disadvantaged backgrounds in classroom settings we often encountered the issue of attention span. The second observation that has been most impressive in our initial work with the children on the machine has been that they have worked a minimum of fifteen minutes at a sitting and it has been our job to terminate the lesson. We have seen no evidence of boredom nor has any child exhibited anything other than intense interest."

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